This is particularly true of the coefficients at the low frequencies. Fig. 1 is based on materials having a noise quieting coefficient of 0.60 or more. For materials which are less efficient a factor of safety should be added[7].

Only certain sound absorbent materials among those listed in various publications will be found to be suitable for duct lining. In addition to a high sound absorbent coefficient a duct lining material should have a low surface coefficient of friction, high resistance to moisture absorption, and should be fireproof and vermin proof. A number of building codes now specify that any sound absorbent material used for duct lining shall have no fire hazard. There are no existing specifications on moisture resistance but the manufacturer should be required to show that the material will not absorb sufficient moisture to cause deterioration or to decrease the sound absorbing efficiency.

If, as is often the case, the length of duct from the main duct to a grille is shorter than the length of lining indicated by using the factor found, this duct may be sub-divided[8] into smaller ducts, so that the value found may be used as shown in Fig. 2.

Example 3. Assume a branch duct, as shown in Fig. 2, is 24 in. wide by 12 in. high and 42 in. long. Use a duct lining factor of 10.

Case I. (No splitters).

Length of lining = $f \times$ minimum dimension = $10 \times 12 = 120$ in.
In this case the duct should be lined for 120 in. which is obviously impossible.

Case II. (Two splitters).

Results in 3 ducts 24 in. wide and 4 in. high.
Length of lining = $f \times$ minimum dimension = $10 \times 4 = 40$ in.
This length of lining fulfills the space limitations of the branch duct which is 42 in. long.

General Suggestions

In some instances where high velocity air is used, a considerable amount of whistle is generated at the grille. This noise is obviously produced after the air leaves the duct and there is no treatment which can be installed in the duct that will reduce this noise. The engineer must take into consideration the type of grille which he intends to use and provide sufficient grille area so that the velocity through the grille is reduced to a point where the grille is not too noisy.

Ducts serving more than one room permit cross talk between the rooms and should be lined with acoustical material. Where the rooms are close together and the ducts short, the ducts should be sub-divided to provide ample acoustical treatment.

Very often in ventilating duct work the engineer feels that it will not be necessary to line ducts if the sound is traveling against the airflow. This, however, is untrue since sound travels so much more rapidly than does the air in even high velocity systems; that it will travel as easily against the airflow as it does with it.

Sounds which are low in pitch are much harder to eliminate from a duct system than sound which is high in pitch, consequently equipment which produces low pitched sounds should be avoided as much as possible.

[7]For coefficients of commercial sound absorbent materials see Bulletin *Acoustical Manufacturers' Association*, 919 No. Michigan Ave., Chicago. Ill.

[8]Patents exist covering the sub-dividing of ducts for installing sound absorbent materials.

Chapter 32

AIR CONDITIONING IN THE TREATMENT OF DISEASE

Operating Rooms, Reducing Explosion Hazards, Nurseries for Premature Infants, Fever Therapy, High Temperature Hazards, Control of Allergic Disorders, Oxygen Therapy, General Hospital Air Conditioning

IN the past few years air conditioning has made considerable progress as an adjunct in the treatment of various diseases. Among the important applications are those in operating rooms, nurseries for premature infants, maternity and delivery rooms, children's wards, clinics for arthritic patients, heat therapy, oxygen therapy, X-ray rooms, the control of allergic disorders, and for the physiological effects in industry.

OPERATING ROOMS

The widest application of air conditioning in hospitals is in operating rooms. Complete air conditioning of operating wards is important because winter humidification is needed to reduce the danger of anesthetic gases, summer cooling with some dehumidification to eliminate excessive fatigue and to protect the patient and operating personnel, and finally filtering for the removal of allergens from the operating room air.

Reducing Explosion Hazard

Explosion hazards in operating rooms began with the introduction of modern anesthetic gases and apparatus. Ether administered by the old drop method is still regarded as comparatively safe; but when mixed with pure oxygen or with nitrous oxide in certain concentrations the explosion hazard may be as great with ethylene-oxygen, or cyclopropane-oxygen mixtures[1]. (See Table 1.)

During the course of ethylene anesthesia the mixture, usually 80 per cent ethylene and 20 per cent oxygen, is so rich that the danger of explosion is slight in the immediate vicinity of the face mask, but leakage of ethylene into the air may accumulate to any lower concentration, and thus introduce a serious hazard. The most dangerous period is at the end of the operation when the patients' lungs and the anesthesia apparatus are customarily *washed out* with oxygen with or without the addition of

[1]Safeguarding the Operating Room Against Explosions, by Victor B. Phillips (*Modern Hospital*, 46, April and May, 1936).